NISTTech

Gradient Elution Electrophoresis

High quality, real- time analysis of hundreds of samples simultaneously with 100 times higher throughput than competing microfluidic systems at one tenth the cost.

Description

This system, called gradient elution moving boundary electrophoresis, is for ultrahigh throughput analysis of chemical or biochemical samples. It is designed to process large numbers of samples in parallel and real time; saving reagents and time while providing massive amounts of data. The system is versatile and can be used for a wide range of applications including: drug discovery, blood or urine analysis, food and beverage analysis, and environmental monitoring (water, soil, etc).

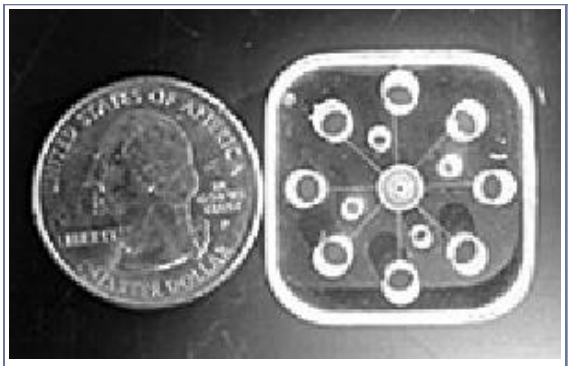
The key to this innovation is not what's in it, but what we took out - the optics. The complicated and expensive laser optics typically used for detection are replaced with a simple 5¢ resistor. This enormous reduction in complexity means that our system can easily be scaled up for simultaneous measurements of practically any number of samples. Published proof- of- concept results with a 16- channel system already demonstrate higher throughput than currently available microfluidic chip- based screening systems, and scale up to 96 or 384 channels would provide 100 times higher throughput than competing systems.

In addition, because the system uses electric fields to separate the individual components of an assay sample, it provides very high quality, reproducible data. This means lower rates of false positives and false negatives, and more reliable detection of weakly acting drug compounds.

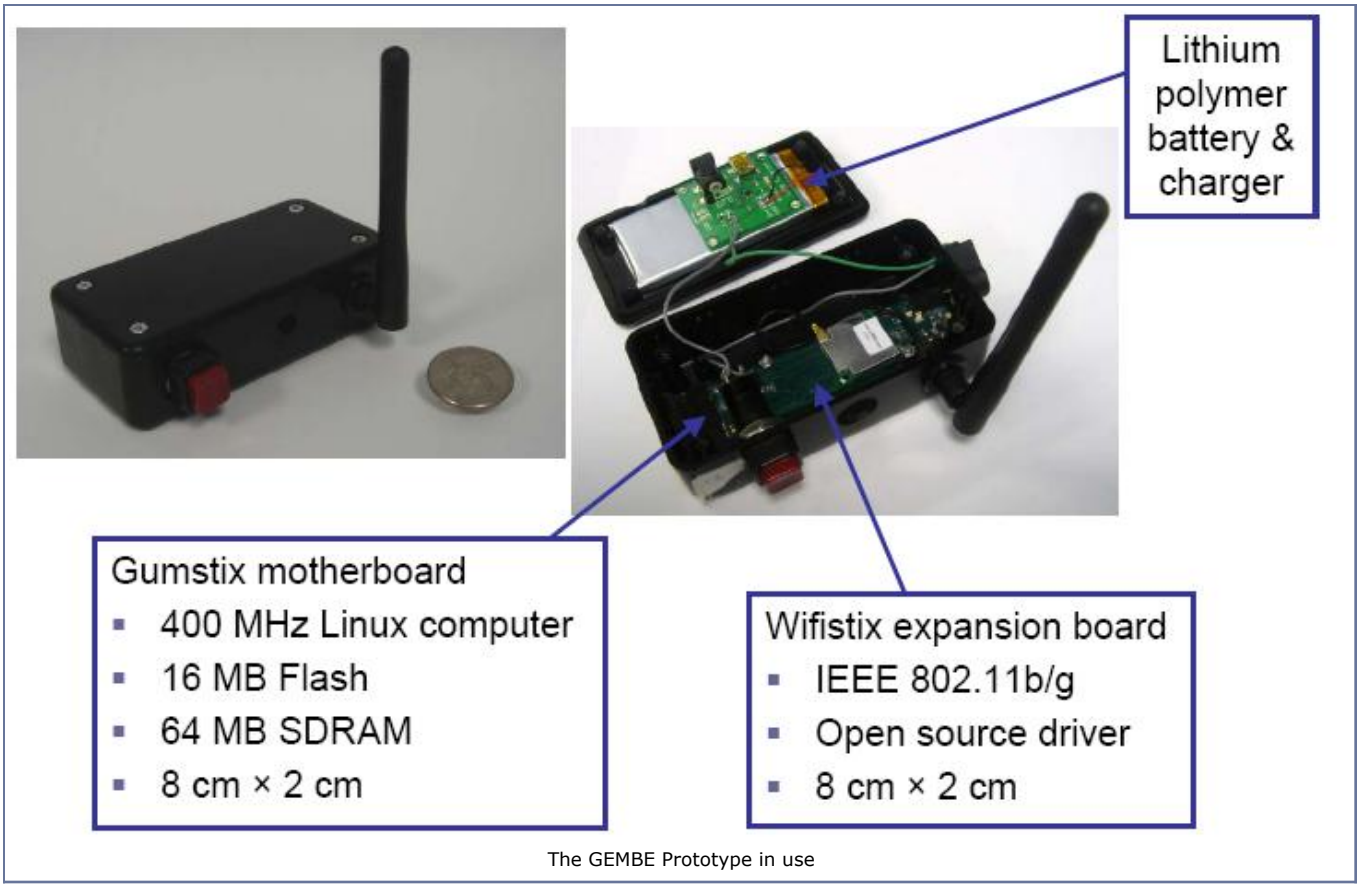
The simplicity of the system also means that it can be made and sold at a fraction of the cost of the competition, and because it doesn't require expensive fluorescently labeled reagents or secondary enzymes, the disposables needed to run the system could also be sold at a much lower cost.

See continuation-in-part U.S. patent application below under Citations.

Images



The core of the new miniature GEMBE chemical separation device is a machined acrylic block, shown with a quarter for scale.



The GEMBE Prototype in use

Applications

- **Drug discovery**
  Can be adapted to be used in drug development and testing
- **Bodily fluids testing**
  Can be designed to do blood and urine analysis
- **Food and beverage analysis**
  Can be applied to food and beverage testing
- **Environmental monitoring**
  Can be used in other environmental applications such as soil and water quality testing

Advantages

- **Simple**
  Laser optics are no longer needed for detection, Infinite Chemical Analysis replaces them with a single resistor
- **Scalable**
  Easy to scale up
- **Cost efficient**
  Inexpensive and does not require expensive fluorescently labeled reagents or secondary enzymes
- **High quality data**

With the use of electric fields to separate the components of the assay, data is accurate, of high quality and easily reproducible

Abstract

Gradient elution moving boundary electrophoresis (GEMBE) is a recently described technique for electrophoretic separations in short (1-3 cm) capillaries or microchannels. With GEMBE, the electrophoretic migration of analytes is opposed by a bulk counterflow of separation buffer through the separation channel. The counterflow velocity is varied over the course of a separation so that analytes with different electrophoretic mobilities enter the separation channel at different times and are detected as moving boundary, stepwise increases in the detector response. The infinite analysis is technology is an implementation of the GEMBE technique in which a very short (0.03-3.5 mm) capillary or microchannel is used as both the separation channel and a conductivity detection cell. Because the channel is so short, only a single moving boundary “step” is present in the channel at any given time, and the measured current through the channel can therefore be used to give a signal comparable to what is normally generated by more complicated detector arrangements.

Inventors

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Citations

1. NIST Docket # 06-011 CIP
2. J.G. Shackman and D. Ross. Gradient elution isotachophoresis for enrichment and separation of biomolecules. Anal. Chem, 79, 6641-6649, 2007.
3. D. Ross and E.F. Romantseva. Gradient elution moving boundary electrophoresis with channel current detection. Anal. Chem, 81, 7326–7335, 2009. DOI: 10.1021/ac901189y.
4. D. Ross and J.G. Kralj. Simple device for multiplexed electrophoretic separations using gradient elution moving boundary electrophoresis with channel current detection. Anal Chem, 80, 9467-9474, 2008. DOI: 10.1021/ac801597e.
5. J.G. Shackman, M.S. Munson, and D. Ross. Gradient elution moving boundary electrophoresis (GEMBE) for high-throughput multiplexed Microfluidic Devices. Anal Chem, 79, 565-571, 2007. DOI: 10.1021/ac061759h.

Related Items

- Article: 'No Muss, No Fuss' Miniaturized Analysis for Complex Samples Developed
- Article: New Miniaturized Device for Lab-on-a-Chip Separations
- MERWYN Business Simulation Report

References

- U.S. Patent 8,080,144 issued 12-20-2011, expires 01/6/2030
- Docket: 06-011

Status of Availability

This invention is available for licensing exclusively or non-exclusively in any field of use.

Last Modified: 09/16/2011